

## Oral (or Nasogastric) Maintenance Therapy for Cholera Patients in all Age-groups \*

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*Oral or nasogastric maintenance therapy with a solution containing glucose and electrolytes has been developed for treating cholera patients in all age-groups. The ingredients of the solution are cheap, need not be sterile, and are widely available in endemic areas. Patients in shock at the time of admission to hospital receive intravenous rehydration before oral maintenance is begun and it is found that their intravenous fluid needs are reduced by 70%–80%. Patients with milder infections, who are not in shock at the time of admission, can be treated with the oral solution alone.*

A maintenance solution of glucose and electrolytes given by mouth or by nasogastric tube has been shown to reduce the intravenous fluid needs of adult cholera patients by 80% (Pierce et al., 1968; Nalin et al., 1968). Detailed balance studies carried out in a research hospital have shown that an oral solution can also maintain water and electrolyte balance and normal serum electrolytes in children with cholera. The practicability of the oral method of maintenance for adults has been demonstrated in the field during an epidemic. The present study shows that the solution developed for children, which contains more potassium than the solution previously studied in adult patients, can maintain water, sodium, potassium, bicarbonate and chloride balance of patients in all age-groups treated at a field hospital.

### METHODS

Altogether, 56 children and 50 adults with uncomplicated, severe cholera were studied. The diagnosis of cholera was confirmed in all cases by cultures of rectal swab specimens. Patients received initial intravenous rehydration with a standard intravenous solution<sup>3</sup> until hypotension and other signs of dehydration (reduced skin turgor, dry tongue, sunken eyes) were corrected. Then patients drank (or received by nasogastric tube) the warmed (40°C–45°C) maintenance solution. When nasogastric tubes were used, the solution was delivered *via* intravenous tubing connecting an inverted bottle to the nasogastric tube.

The oral solution contained the following ions (as milliequivalents per litre of water) Na<sup>+</sup>, 120; K<sup>+</sup>, 25; CO<sub>2</sub><sup>-</sup>, 48; Cl<sup>-</sup>, 97; and glucose (110 mmol/l) as shown in the accompanying table. Patients were given nothing by mouth except the maintenance solution and a 5-day course of tetracycline (124 mg every 6 hours for children; 250 mg every 6 hours for adults).

Intake and output were recorded over periods of 4 or 6 hours; 6-hour periods were found to be most satisfactory in the field hospital. During the first intake and output period, children received

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<sup>3</sup> The intravenous solution contained sodium (132 mEq/l), potassium (13 mEq/l), bicarbonate (48 mEq/l) and chloride (97 mEq/l).

COMPOSITION OF ORAL SOLUTION FOR CHOLERA THERAPY <sup>a</sup>

Composition	Cholera stool		Oral solution
	Child	Adult	
Na <sup>+</sup> (mEq/l)	104	145	120
K <sup>+</sup> (mEq/l)	26	12	25
Cl <sup>-</sup> (mEq/l)	85	85	97
CO <sup>2-</sup> (mEq/l)	45	48	48
Glucose (mmol/l)	—	—	110

<sup>a</sup> The object of therapy is to maintain a positive water and electrolyte balance. Absorption in excess of deficit is compensated by increased urine output. The electrolyte composition of the oral solution is designed to maintain positive electrolyte balance in both children and adult cholera patients. The electrolyte concentration of the oral solution equals, or is slightly greater than, that of the stool except in respect of sodium in the adult stool. In the latter, positive sodium balance is maintained despite the difference in concentration because patients receive volumes of oral solution which exceed their diarrhoeal volumes. Stool composition is based on mean values during the first 24 hours for 27 children and 10 adult patients with cholera who were treated with tetracycline and intravenous solution only. The stool composition of 12 paediatric and 19 adult patients maintained on oral therapy has been measured and is essentially the same.

250 ml of the maintenance solution per hour and adults received 750 ml. If necessary, the amount was increased or decreased to match initial diarrhoeal losses. The amount of solution given in each subsequent intake and output period was equal to the volume of diarrhoea during the preceding period. Since the volume of diarrhoea decreases exponentially with time (Carpenter et al., 1965), the patient is kept in positive balance by matching the previous volumes of diarrhoea and vomitus with equal volumes of oral solution. The net intestinal balance was calculated by deducting the volume of diarrhoea and vomitus from the volume of oral or nasogastric intake at the end of each intake and output period. When the oral or nasogastric intake exceeded the diarrhoeal output, the net intestinal balance was positive.

The plasma potassium of 50 adult patients was determined from 12-hourly plasma samples sent from the field hospital to the laboratory.

## RESULTS

### Children

All children were maintained in positive balance with the oral (or nasogastric) solution after correc-

tion of shock by intravenous rehydration. The mean volume of oral solution required by the 56 children was 6 litres.

In the field trial of paediatric oral solution on the group of children the average amount of intravenous fluid needed was 1.3 litres, most of which represents the amount needed for the correction of shock on admission. The reduction in intravenous fluid needs, resulting from use of the maintenance solution, is reflected by the difference between the 1.3 litres mean intravenous fluid requirement and the 4.6 litres mean diarrhoeal volume as shown in the following tabulation:

	<i>Means and ranges</i>
Weight (kg)	13.2 (6.3–20.7)
Age (years)	5.3 (2–11)
Diarrhoea (litres)	4.6 (0.3–16.4)
Intravenous fluid (litres)	1.3 (0.2–3.2)
Duration (hours)	30 (5–61)

Altogether, 80% of the patients were in positive net intestinal balance by 6 hours after oral therapy was started. After positive balance was achieved, reversion to negative balance did not occur. Vomiting after admission occurred in half the patients but was not a significant problem because volumes of vomitus were small in relation to oral input (mean volume, 0.8 litre). Vomiting was uncommon after the first 8 hours.

### Adults

The response of the group of adult patients was similar to that reported earlier (Nalin et al., 1968). The average intravenous requirement for rehydration was 3 litres; the volume of diarrhoea averaged 12 litres. The group of adult patients was studied to determine whether the oral solution for children, containing 25 mEq of potassium per litre, was safe for adults; it was found that plasma potassium levels remained normal.

## DISCUSSION

The traditional approach to treating various kinds of diarrhoea includes the curtailment of oral intake. This study illustrates that an oral solution of electrolytes and glucose can be absorbed by cholera patients of all ages and can maintain fluid and electrolyte balance. The most severely ill patients still require some intravenous fluid to correct shock before oral maintenance is begun. However, total intravenous fluid requirements are reduced by 70%–80% compared with previous groups of patients treated with intravenous therapy alone (Linden-

baum, Greenough & Islam, 1967a, 1967b). Altogether, 500 patients with mild cholera have been treated at the field hospital by means of oral therapy alone.

The oral solution has also been found to maintain fluid and electrolyte balance in patients with non-specific diarrhoeas resembling cholera. Some workers have used intraperitoneal maintenance in situations where intravenous infusion could not be maintained (Ransome-Kuti et al., 1969). The use of oral maintenance obviates the need for intra-

peritoneal maintenance, which is of little benefit in severe diarrhoea.

The major benefits of oral maintenance therapy are wide availability and low cost; these are life-saving factors in endemic cholera areas where intravenous fluids are scarce and expensive. The solution reported here extends these benefits to children with cholera. The fact that the oral solution can be used in both children and adults makes it very convenient for use in large-scale epidemics in endemic areas.

## RÉSUMÉ

### TRAITEMENT D'ENTRETIEN DU CHOLÉRA, PAR VOIE ORALE (OU NASO-GASTRIQUE), CHEZ DES MALADES APPARTENANT À TOUS LES GROUPES D'ÂGE

Après avoir subi un traitement réhydratant initial par voie intraveineuse, 56 enfants et 50 adultes atteints d'une forme grave de choléra bactériologiquement confirmé ont reçu du liquide de remplacement par voie orale ou nasogastrique. L'emploi d'une solution contenant du glucose et des électrolytes a permis de maintenir l'équilibre hydrique et électrolytique et de réduire dans la propor-

tion de 70 à 80% les besoins en liquides introduits par voie intraveineuse.

Les auteurs insistent sur les avantages de ce traitement d'entretien qui, en raison de sa technique aisée et de son coût peu élevé, est susceptible de rendre de grands services en cas de survenue d'importantes épidémies.

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